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Systems & Functional Materials for Advanced Core Analysis,
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Advanced Rubber Compounds for Core Analysis and Earth Sciences
July, 2004

The complex forms used in specialised testing are designed in close collaboration with clients. To ensure product success, carefully evolved design steps are observed in association with an advanced rubber technology company (Elastomer Engineering Ltd) . This close co-operation has been is force for over 24 years, whereas Elastomer Engineering has over 38 years expertise in product design and manufacture in a broad field of "state of the art" rubber moulding and metal to rubber bonding applications.

The products are manufactured by a variety of techniques:

- Mandrel wrapping and grinding
- Compression moulding
- Injection moulding
- Transfer moulding
- Casting
- Fabrication

These enable the production of plain bore sleeves and tubes or complex forms with spatially bonded metal alloy (Stainless steel , Titanium & Hastelloy etc.) and engineering plastic (PEEK & Vespel) components . The bonded parts can be solid or complex shapes for instrument or transducer mounting or they can be pressure ports or electrodes for measuring the properties of the samples under testing.

The following rubber compound are available:

- Polyetherurethane
- Natural Rubber
- Nitrile 2 grades
- Hydrogenated Nitrile
- Fluoroelastomer 'B'
- Fluoroelastomer 'GF'
- Viton Extreme® - a trademark of DuPont Performance Elastomers
- Perfluoroelastomer

The important mechanical engineering and chemical properties of each compound with its suggested compatibility and application is given.

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Properties and Application of Rubber Compounds in Core Analysis and Earth Sciences (July.2004)

Nitrile Rubber - Core Analysis formulation

This is a low extractable product with no plasticisers and anti-oxidants added to minimise the amount possible leached constituents by the process fluids during testing.

Nitrile rubber is resistant to brine, mineral oils and methanol, having a working temperature range between -15° C to 100° C. t is not resistant to hot air or ozone and it swells in toluene. Although resistant to methanol, it should not be used with polar solvents such as esters and ketones, nor with chlorinated solvents.

Nitrile Rubber - Earth Sciences formulation

Mechanically stronger than the C.A. formulation with plasticisers and anti -oxidants and it is intended for jacketing rock mechanics test samples in strength testing. The working temperature range is between -25 ° C and 100° C.

Hydrogenated Nitrile

Hydrogenated nitrile rubber has similar oil and solvent resistance to ordinary nitrile but the temperature range is extended to 150° C. It is resistant to hot air and ozone.

This rubber is a cost effective choice in comparison with fluoro-elastomer rubber at higher temperature testing when solvent resistance is not required.

Fluoro-elastomer type "B"

Type "B" fluoro-elastomer has a working temperature range of -10° C to

250° C and is resistant to oils and toluene. It is only moderately resistant to methanol. It withstands ozone and most aqueous acid and alkaline solutions, but should not be used with polar solvents such as esters or ketones.

Fluoro-elastomer type "GF"

Type "GF" fluoro-elastomer has a superior solvent resistance to type "B", but it should not be used with esters and ketones. It has a good resistance to methanol, making it an excellent choice for use in methanol/toluene flooding extraction procedures.

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Polyetherurethane (P.U.)

This a versatile prototyping rubber as it is made into products by casting and fabrication techniques, requiring reduced tooling cost even with complex bonded inserts. It is resistant to mineral oils and aqueous alkali and acid solutions. Its service temperature is limited to 40° C.

General Application Note

70 IRHD hardness rubber is normally recommended for sleeves in core analysis using solvents and high temperature testing. 60 IRHD is used in room condition core analysis, rock mechanics testing and core preservation.

Summary of Properties *

	C.A. Nitrile	E.S. Nitrile	Hyd. Nitrile	Fluoro-el. "B"	Fluoro-el. "GF"	P. U.	P. U.
PROPERTY							
Hardness ~ IRHD	60+5/-4	60+5/-4	70-75	70-75	70-75	60-65	80-85
Relative Density Mg/m^3	1.14+/-0.02	1.22+/-0.02	1.19+/-0.02	1.85+/-0.02	1.89+/-0.02	1.04+/-0.02	1.05+/-0.02
Tensile Strength MPa	11.9	14.9	25	11.1	12.5	24	30
Elongation at Break %	550	625	300	300	250	500	500
Compression Set % 24hours at° C	25 70	20 100	22 150	23 200	25 200	18 22	19 22
Heat Aged 72hours at° C	70	100	150	200	200	N/A	N/A
Tensile Strength Change %	-+14	-6	-5	+10	-5	N/A	N/A
Elongation Change %	+5	-20	-+3	-16	+20	N/A	N/A
Hardness Change ~IRHD	+2	+6	+4	+1	0	N/A	N/A
Fluid Resistance to	A	A	A	B	B	N/A	N/A
Weight Change %	+27	+10	+28	+6	+5	N/A	N/A
Volume Change %	+38	+20	+41	+13	+7	N/A	N/A
Fluid Resistance to Methanol at 40° C						N/A	N/A
Weight Change %	+13	+0/-5	+10	+5	+2	N/A	N/A
Volume Change %	+20	+5	+16	+10	+4	N/A	N/A

IRHD= International Rubber Hardness Degree
A =30/70 v/v Toluene/Iso-Octane 24 hours at 40° C
B = Toluene 24 hours at 40° C
N/A= Not applicable
* Test Method in accordance with relevant parts of BS903